

SECTION 16360

15 KV PAD-MOUNTED SWITCHGEAR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. 15 KV pad-mounted switchgear.

1.2 QUALITY ASSURANCE

- A. Comply with ANSI C2 — *National Electrical Safety Code*.
- B. Comply with ANSI/NFPA 70 — *National Electrical Code*.
- C. Provide products suitable for operation at 7500 ft. altitude.

1.3 SUBMITTALS

- A. Provide the following submittals according to the requirements of Sections 01300 and 01700.
 - 1. Catalog Data: Submit catalog data for components and accessories proving that products comply with specified requirements.
 - 2. Shop Drawings: Submit shop drawings for each 15 KV pad-mounted switchgear. Include dimensioned plans and elevations and component lists. Show ratings, including short time and short circuit ratings.
 - 3. Installation Instructions: Include manufacturer's instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
 - 4. Operation and Maintenance Instructions: Include maintenance instructions for cleaning methods, cleaning materials recommended, instructions for testing, adjustment, and lubrication
 - 5. Certifications: Submit manufacturer's certification of ratings of the basic switch components and the integrated pad-mounted gear components in combination with the enclosure. This certification on the integrated unit shall include testing the switchgear to the fault close requirements of the specifications to assure the bus support system is adequate, as well as the switch itself.
 - 6. Test Reports: Submit certified test reports of similar units showing fault closing capability and load interrupting capability of switches, including the bus, based on maximum design voltage. Submit certified test reports proving capabilities of enclosure finish system.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspect pad mounted switchgear units on delivery and report concealed damage to the carrier within their required time.
- B. Handle pad mounted switchgear units carefully to avoid damage to internal components, enclosure, and finish. Follow manufacturer's instructions for rigging, lifting and handling of switchgear units.

- C. Store pad mounted switchgear units in a clean, dry environment. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic. Provide space heaters as required to prevent condensation of moisture within the switchgear housing during storage.

1.5 EXTRA MATERIALS

With each switchgear unit provide one spray can of touch-up paint that matches switchgear finish. Provide Material Safety Data Sheet (MSDS) for the touch-up paint.

PART 2 PRODUCTS

2.1 DESCRIPTION

Provide outdoor pad-mounted 15 kV gear consisting of a single self-supporting enclosure, containing four three-phase, gang-operated load interrupter switches and isolated tie bus with the necessary accessory components, all completely factory assembled and operationally checked.

2.2 RATINGS

- A. The ratings for the integrated pad-mounted gear shall be as designated below:

- 1. Kv, Nominal: 14.4

- 2. Kv, Maximum Design: 17.0

- 3. Kv, BIL at 7500' altitude: 95*

- *110 Kv equivalent BIL at sea level

- 4. Main Bus Continuous, Amperes: 600

- 5. Three-Pole Interrupter Switches

- a. Continuous, Amperes: 600

- b. Loadbreak, Amperes: 600

- c. Three-Time Duty-Cycle Fault Close
Amperes RMS Asymmetrical: 40,000

- 6. Short-Circuit Ratings

- a. Amperes, RMS Symmetrical: 22,000

- b. MVA Three-Phase Symmetrical at
Rated Nominal Voltage: 550

- 7. The momentary current ratings for the 15 KV pad-mounted switchgear shall be equal to the fault close rating of the interrupter switch.

2.3 ENCLOSURE DESIGN

- A. Design the pad-mounted gear assembly according to the minimum construction specifications of the interrupter switch manufacturer and to provide adequate electrical clearances for operation at 7500 ft altitude.

- B. In establishing the requirements for the enclosure design, consider all relevant factors such as controlled access, tamper resistance, and ventilation.
- C. Design enclosure to be rodent proof with maximum 1/2" diameter unprotected openings.

2.4 ENCLOSURE CONSTRUCTION

- A. Provide pad-mounted gear enclosure that is of unitized construction (not structural-frame-and bolted-sheet) to maximize strength, reduce weight, and inhibit internal corrosion.
- B. Use as the basic material 11 gauge hot-rolled, pickled, and oiled steel sheets.
- C. Weld all structural joints and butt joints; grind external seams flush and smooth. Use a welding process that eliminates alkaline residues and reduces distortion and spatter. Grind and sand (wire brush if internal) any welds made by other than this method to remove all scale and alkaline residues formed during welding.
- D. To guard against unauthorized or inadvertent entry, do not use any externally accessible hardware for enclosure construction.
- E. Provide enclosure base consisting of continuous 90-degree flanges, turned inward and welded to the corners, for bolting to a concrete pad.
- F. Provide door openings with 90-degree flanges, facing outward, to provide strength and rigidity and deep overlapping between doors and door openings to prevent water entry.
- G. Apply a heavy coat of insulating "no-drip" compound to the inside surface of the roof to prevent condensation of moisture thereon.
- H. Provide full-length steel barriers separating adjoining switch compartments.
- I. Provide removable lifting tabs. Sockets for the lifting tab bolts shall be blind-tapped. Provide a resilient closed-cell neoprene material between the lifting tabs and the enclosure finish.
- J. Provide a non-compartmented steel base spacer to increase the elevation of live parts by 12 inches. The spacer shall meet ANSI C2 requirements.

2.5 DOORS

- A. Construct doors of 11 gauge hot-rolled, pickled, and oiled steel sheets.
- B. Provide door-edge flanges that overlap with door opening flanges to create a mechanical maze to guard against water entry and discourage tampering or insertion of foreign objects, but allow free-flow ventilation.
- C. Give doors a minimum of three stainless steel hinges and hinge pins. Weld the hinge pins in place to guard against tampering.
- D. Equip each door with a positive action three-point latching system.
- E. Provide each door with a recessed stainless steel door handle. The door handle shall be pad-lockable and shall incorporate a hood to protect the padlock shackle from tampering. Provide the handle with a recessed pentahead bolt for additional security.
- F. Provide each door with a galvanized steel door holder. Holders shall be hidden from view when the door is closed. Design holder with positive restraint to prevent it from swinging inside the enclosure.

2.6 FINISH

- A. During fabrication, give the areas of structural parts that may later become inaccessible, a phosphatizing bath and an iron-oxide zinc-chromate anticorrosion primer.
- B. Provide full coverage at joints by processing enclosures independently of components such as doors and roofs before assembly into the unitized structures.
- C. Fill and sand all exterior seams smooth for neat appearances.
- D. Before any protective coatings are applied, pre-treat all surfaces to remove oils and dirt, to form a chemical and anodic neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion.
- E. Apply a rust-resistant epoxy ester primer and an epoxy-modified alkyd or an acrylic resin finish coat. Provide light gray, No. 79, ANSI Standard Z55.1 finish. Bake the cabinet at 350°F to produce finish of 4 mils average thicknesses after baking.
- F. Apply the finishing system without sags or runs for a uniform appearance.
- G. Minimum bottom 3" inside surface and outside surface shall be covered with a coal tar epoxy minimum 10 mils thick.
- H. After the enclosure is completely assembled and the components (switches, bus, etc.) are installed, inspect the finish for scuffs and scratches. Carefully touch up blemishes by hand to restore the protective integrity of the finish.
- I. Fabricate hardware (door fittings, fasteners, etc.), operating-mechanism parts and other parts subject to abrasive action from mechanical motion from either nonferrous materials, or galvanized or zinc-plated ferrous materials. Do not use cadmium-plated ferrous parts.
- J. Enclosure shall withstand a prying leverage of 75 foot-pounds applied to all joints, crevices, hinges, seams, and locking means. All such openings shall prevent insertion of number 10 AWG hard-drawn copper wire after the prying leverage has been applied.

2.7 BUS

- A. Provide bus and interconnections consisting of 98% conductivity copper bars.
- B. Install the bus and interconnections to withstand the stresses associated with short-circuits up to the maximum rating of the pad-mounted gear, including allowance for transient conditions.

2.8 INSULATORS

- A. Provide epoxy resin mounting insulators with characteristics and restrictions as follows:
 - 1. Operating experience of at least 10 years under similar conditions.
 - 2. Ablative action to ensure non-tracking properties.
 - 3. Adequate leakage distances established by test per IEC Publication 507.
 - 4. Adequate strength for short-circuit stress established by test.
 - 5. Conformance with applicable ANSI Standards.

- B. Homogeneity of the epoxy resin throughout each insulator shall provide maximum resistance to power arcs. Test each insulator to ensure the synthetic material is homogeneous. X-ray each insulator to assure it is void free.
- C. Arrange the supporting insulators so they may be inspected for contamination, etc., from the switch or cable entrance compartments. Designs that require the removal of panels or the roof to inspect any support insulators will not be acceptable.

2.9 GROUND-CONNECTION PADS

- A. Provide a ground-connection pad in each compartment of the pad-mounted gear.
- B. Construct the ground-connection pads of steel, 3/8" thick, copper clad and welded to the enclosure. Installed ground pads shall have a momentary rating equal to that of the integrated assembly.
- C. Coat ground-connection pads with an oxide inhibitor and sealant before shipment.

2.10 INTERRUPTER SWITCHES

- A. Provide interrupter switches that have a three-time duty-cycle fault-close rating as scheduled. This rating defines the ability to close the interrupter switch three times against a three-phase fault with a symmetrical current in at least one phase equal to the rated value; the switch will remain operable and able to carry and interrupt rated current. Perform tests proving these ratings at maximum design voltage with current applied for at least 10 cycles.
- B. Provide interrupter switches with a quick-make, quick-break mechanism installed by the switch manufacturer. Integrally mount the quick-break mechanism on the switch frame. The mechanism shall swiftly and positively open and close the interrupter switch independent of the switch-operation hub speed.
- C. Interrupter switches shall be operated by means of an externally accessible switch-operating hub. The switch-operating hub shall be located within a recessed pocket mounted on the side of the pad-mounted gear enclosure and shall fit a deep-socket wrench or a shallow-socket wrench with extension. The switch-operating hub pocket shall include a pad-lockable access cover that shall incorporate a hood to protect the padlock shackle from tempering. Provide stops on the switch-operating hub to prevent over-travel and by that guard against damage to the interrupter switch quick-make, quick-break mechanism.
- D. Provide each interrupter switch with a switch-operating handle. The switch-operating handle shall be secured to the inside of the switch-operating hub pocket by a brass chain. Store the handle behind the closed switch-operating hub access door.
- E. Completely assemble and adjust each interrupter switch on a single rigid mounting frame of welded steel construction.
- F. Interrupter switch contacts shall be of silver-to-silver construction, and shall be backed up by stainless steel springs to provide constant high contact pressure.
- G. Provide interrupter switches with a single blade per phase for circuit closing including fault closing, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades will not be permitted.
- H. Circuit interruption shall be accomplished by use of an interrupter that is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence. Circuit interruption shall take place with no external arc or flame. Vent any exhaust in a controlled manner.

- I. Interrupter switches shall have a readily visible open gap when in the open position to allow positive verification of correct switch position.
- J. Provide interrupter switches with hinge end terminal pads that guard the switch against damage due to excessive cable or foundation movement.
- K. All current carrying components including switch parts shall be copper or bronze.
- L. Provide shaft locks to mechanically secure switches against movement from either the open or closed position.
- M. Provide grounding studs at all switch terminals. Also, provide grounding studs on the ground pad for each terminal in each compartment. The momentary rating of the grounding studs shall equal or exceed the momentary ratings of the pad-mounted gear.
- N. Provide mounting provisions to hold one three-phase fault indicator with three-single-phase sensors in each switch compartment. Provide viewing windows in doors to permit inspection of fault indicators without opening the doors.
- O. Provide terminal adapters to fit two NEMA 2-hole connector lugs per terminal at each switch.

2.11 INSULATING BARRIERS

- A. Provide insulating interphase and end barriers of fiberglass reinforced polyester for each interrupter switch to achieve BIL ratings. Provide insulating barriers of the same material to separate the front compartments from the rear compartments and isolate the tie bus.
- B. Provide interrupter switches with dual purpose front barriers. These barriers, in their normal hanging positions, shall guard against inadvertent contact with live parts. It shall be possible to lift these barriers out and insert them into the open gap when the switch is open. Provide a window panel to allow viewing of the switch position without removing the barriers. These barriers shall meet the requirements of Section 381.G of the ANSI C2.

2.12 LABELING

- A. Provide all external doors "Caution-High Voltage, Qualified Persons Only" signs.
- B. Provide "Danger-High Voltage, Qualified Persons Only" signs inside each door and on each of the front insulating barriers.
- C. Provide warning signs saying "Switch Blades May Be Energized in Any Position" inside each door providing access to interrupter switches.

2.13 RATING NAMEPLATES AND DIAGRAMS

- A. Provide nameplates showing the manufacturer's name, catalog number, and model number on the outside of each door.
- B. Provide nameplates inside each door showing the following:
 - 1. Voltage Ratings - (kV, nominal; kV, maximum design; and kV, BIL.)
 - 2. Main Bus Continuous Ratings - (Amperes)
 - 3. Short-Circuit Ratings - (Amperes, RMS. symmetrical and MVA three-phase symmetrical at rated nominal voltage.)

4. Interrupter Switch Ratings - (Amperes, continuous amperes, live switching load splitting and load dropping; amperes, fault-closing, duty-cycle, three-time-RMS symmetrical, RMS asymmetrical and peak, amperes, short-time, RMS-momentary, asymmetrical and one second symmetrical.)
- C. Provide a three-line connection diagram showing interrupter switches and bus along with the manufacturer's model number inside the front and rear doors and inside each operating hub access cover.

2.14 MANUFACTURERS

Electrical Equipment Inc. Model PSI-10, Catalog 44400-A3-B4-F3-G2-H-K2-P-T5-T7-SP.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install 15 KV pad-mounted switchgear following manufacturer's instructions at locations indicated on the Drawings.
- B. Install on concrete base as specified below. Install a closed cell neoprene gasket between the steel base and the concrete pad.
- C. Terminate each conduit with a bell end fitting set 2 inches above the concrete pad.
- D. Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear unit after it is set on concrete base.
- D. Connect each grounding pad to the grounding conductor in the duct bank or manhole.
 1. Use #4/0 AWG bare copper ground cable.
 2. Use hydraulically compressed connectors and NEMA two-hole lugs that have been tested successfully according to the requirements of IEEE Std. 837 - *IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding*.
 3. Use UL listed ground plates designed for flush mounting in concrete structures. Furnish copper alloy castings with four 1/2 inch threaded holes at 1.75" x 1.75" NEMA spacing and a #4/0 AWG welding stud or compression connection. Install a grounding plate for each switchgear compartment in concrete base, next to the conduit.
- E. Tighten electrical connectors and terminals, including grounding connections, according to the manufacturer's published torque-tightening values.
- F. Seal conduits after cables are installed to exclude rodents and reptiles. Refer to Section 16115 — UNDERGROUND DUCTBANKS AND MANHOLES.

3.2 CONCRETE BASE

- A. Install switchgear on a reinforced concrete pad with the following dimensions:
 1. Pad dimensions: 6 inches larger in both directions than supported unit.
 2. Pad thickness: 8 inches, extending 4 inches above grade.

Edit 3 to match Project requirements. The perimeter stem may need to extend as much as 48" below grade when in alluvial soil that retains significant moisture and thus heaves significantly when frozen.

- 3. Continuous perimeter stem: 12 inches thick, extending to 12" below grade.
- B. Form concrete equipment bases using framing lumber with form release compounds. .
- C. Reinforce pad and stems with two layers of #4 reinforcing bars spaced 12" each way, top and bottom. Use deformed bars that conform to ASTM A 615, grade 60.
- D. Use concrete with a 28 day compressive strength of 4000 psi. Chamfer top edges and corners. Cure concrete seven days before installing equipment.
- E. Anchor equipment to pad using not less than four 5/8" diameter anchor bolts set 4" into pad.

3.3 IDENTIFICATION

Install electrical identification on 15 KV pad-mounted switchgear and conductors according to Section 16195 ELECTRICAL IDENTIFICATION.

3.4 CLEANING

Upon completion of installation, inspect interior and exterior of 15 KV pad-mounted switchgear. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.5 FIELD QUALITY CONTROL

- A. Visually inspect for physical damage, alignment, and fit.
- B. Perform mechanical operator tests following manufacturer's instructions.
- C. Perform testing according to Section 16950 ELECTRICAL ACCEPTANCE TESTING.

END OF SECTION